

Development of Control Theoretical Approaches in Biology and Medicine

Esteban A. Hernandez-Vargas^{*,**} Pablo Rivadeneira^{***}
Claudia Califano^{****} Griselda Quiroz[†]

^{*} *Frankfurt Institute for Advanced Studies, Frankfurt, Germany.*

^{**} *Instituto de Matemáticas, UNAM, Unidad Juriquilla, México.
(e-mail: esteban@im.unam.mx)*

^{***} *Departamento de Energía Eléctrica y Automática, Universidad Nacional de Colombia, Medellín, Colombia (e-mail: psrivade@unal.edu.co)*

^{****} *DIAG, Università di Roma, via Ariosto 25, 00184 Roma, Italy.
(e-mail: claudia.califano@uniroma1.it)*

[†] *Universidad Autónoma de Nuevo León, FIME, Av. Universidad S/N, Ciudad Universitaria, C.P. 66455, San Nicolás de los Garza, Nuevo León, México (e-mail: griselda.quirozcm@uanl.edu.mx)*

Abstract: Expectations for the future of control engineering approaches in medical applications are very high. Nonetheless, several significant technical challenges such as the incorporation of multiscale data, delayed and infrequent measurements as well as poor model representations of biological systems stand on the way. The proposed invited track session aims to exchange ideas on on-going efforts and obstacles by the members of the control engineering community in different biological and medical applications. Furthermore, this invited track will bring together the key challenges, insights, tools and theoretical developments arising from personalized medicine such as:

- Optimal and/or robust control strategies to tailor therapies in different diseases.
- Observers with sampled measurements available after time-varying intervals.
- Development of control and observers with time delay.
- Applications of data-driven modelling and machine learning in control of diseases.
- Control of complex biological networks.

For more details of the invited track follow us on <https://twitter.com/Ifac2020S>.

Keywords: Biomedical Applications, Systems Biology, Personalized Medicine.

1. OPEN INVITED TRACK DESCRIPTION

Scheduling therapies to control diseases has been performed by integrating empirical knowledge and information from clinical trials. However, this “trial and error” approach is challenging and unfeasible by the steep increase in the number of different pieces of information and the complexity of large datasets.

In the era of “big data”, a systematic and tractable approach that integrates a variety of biological and medical research data into mathematical models and computational algorithms is crucial to develop new therapies towards personalized medicine. The open invited track session for 21st IFAC World Congress in Berlin has the purpose to bring together experts in control engineering aiming to personalize drug therapies for different diseases (but not limited to): infectious diseases, diabetes type 1 and 2, cancer, neurological diseases among others.

A central part of the open invited track session will be devoted to present innovative theoretical tools to schedule therapies in infectious diseases. This is very relevant to global health care as infectious diseases remains a major

public health threat worldwide, with evidence of continuing transmission and drug resistance. Regarding diabetes treatment, results showing that future hypoglycemic events are predicted and thus avoided are particularly welcomed. Precision medicine for cancer treatment is gaining more and more attention in the last years. The use of control strategies could be of relevant importance in the definition of personalized treatment. Recent advances in the study of neurodegenerative diseases, such as the Alzheimer, Parkinson and Huntington diseases, are also focusing on risk factors which may help in predicting their appearance, as well as to personalize drug therapies to slow down the progressing of the illness. Contributions on these topics are also solicited.

Ultimately, a key goal of this invited session is to attract Ph.D. students and young researchers to enter the fascinating new area of systems medicine that will cross-fertilize the research activity in the years to come, in control engineering and beyond.

Use the code **5a75x** to submit your contribution to the open invited track. More news of the invited track will be posted on <https://twitter.com/Ifac2020S>.